

REMARKS

Reconsideration of the present application is respectfully requested.

Each of independent claims 1, 16 and 18 has been amended to more clearly distinguish over the prior art.

Each of the independent claims recites, either in method terms or apparatus terms, that a damping force having substantially the same frequency as that of the tool vibration's oscillatory motion is applied in counter-direction to a velocity of the vibration and out-of-phase therewith by other than 180 degrees.

In Huang et al., the oscillation of the workpiece mounting fixture is detected, and actuators are actuated for providing a force for damping the oscillation. Even assuming for the sake of argument that it could somehow be considered obvious to apply a damping force to the cutting tool rather than to the workpiece fixture, there is no disclosure in Huang et al. of applying the damping force in a direction counter to the direction of the vibration's velocity and out-of-phase therewith by other than 180 degrees, as presently claimed. Huang et al. is silent with respect to those parameters. Rather, Huang et al. discusses, in general terms, that amplitude, phase, and frequency are to be taken into account when establishing a damping force, but never specifies the direction of the damping force and certainly doesn't provide details relating to the phase relationship. One could reasonably expect that a 180° out-of-phase relationship would be provided, which the present inventors have discovered is not easily accomplished, but have found that applying the damping force in a direction opposite the vibration's direction in a non-180 degree out-of-phase relationship, is a more reliable way to achieve damping.

Furthermore, it is submitted that it would not have been obvious to employ the damping technique of Huang et al. to cutting tools, regardless of the teachings of Redmond et al. The pattern of vibration for a workpiece will differ

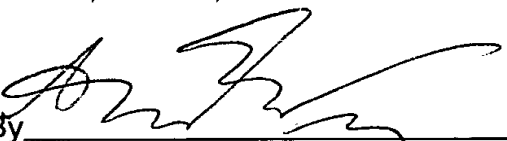
dramatically from that of a cutting tool and furthermore the Huang system is intended to be applied to a range of workpieces which can be mounted in the active fixture. Apart from the system being able to deal with different workpieces the pattern of vibration will vary considerably even when considering a single workpiece. In other words the design of the workpiece itself will have an influence, one pattern of vibration in areas where the workpiece is massive and quite a different pattern if the workpiece is not massive. The physical nature of the workpiece material variations in hardness and surface finish can also lead to differences in vibration patterns. A further complication will be that a localized vibration for example in the area of a bore may be sensed in different manners because the sensors are relatively remote from the source of vibration and the vibrations will be transmitted in different ways according to the intermediate material. Distance from the point on the workpiece where the vibration is generated and the sensor which monitors the vibration will also be a significant factor. Differences in distance will mean differences in time for the correction motion to be applied to the point of vibration and hence great uncertainty as to whether or not the damping action will function when and where required. Similar doubts can be raised as regards the clamping of the workpiece in the active fixture and consistency of the signals to and from the point of vibration.

Redmund et al. does not teach that a system designed specifically to dampen the vibrations in a workpiece fixture, to deal with the nuances discussed above, could instead be applied to a cutting tool.

For the reasons outlined above, it is submitted that the presently claimed invention could not be considered as obvious over the applied prior art and allowance of the application is respectfully requested.

Respectfully submitted,

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